SUBSTITUTE SPECIFICATION

GATEWAY AND DISTRIBUTED SYSTEM USING THE GATEWAY

TECHNICAL FIELD

[0001] This invention relates to a gateway for connecting a plurality of networks having different characteristics, and a distributed system using this gateway.

BACKGROUND OF THE INVENTION

[0002] In the recent development of the automobile, various electronic apparatuses have been loaded on the automobile, including audio instruments, a navigation device, an engine controlling device, a driving device for a mission, for example, and these electronic apparatuses are connected to different networks depending upon their characteristics. To a network for an information system, there is connected an apparatus operating in response to an input (input of an event) from the outside, such as the output of an audio instrument; and, to a network for a control system, there is connected an apparatus for outputting information at a predetermined period, such as an engine controlling apparatus.

[0003] Japanese Patent Application Laid-Open No.11-8647(1999) discloses a gateway for use in connecting plural LANs which have different protocols. However, in such prior art publication, there is no description of a gateway connecting networks which are different in character, such as a so-called information system network and a so-called control system network for example. Specifically, there is no disclosure in the above-mentioned publication of the transmission of information between an information system network in which information is transmitted in response

to an event and a control system network in which information is transmitted at a constant period.

SUMMARY OF THE INVENTION

[0004] An object of this invention is to provide a gateway which can connect an information system network and a control system network and can carry out the exchange of information between the information system network and the control system network, and to provide a distributed system using this gateway.

[0005] Characteristic features of this invention for obtaining the above-mentioned object are as follows. The object of this invention can be achieved by an individual or any combination of these characteristic features.

[0006] The gateway operates to send and receive a message which is transmitted periodically, as well as to send and receive a message which is transmitted in response to an event, or a request or demand.

[0007] Also, the gateway, upon the detection of a change in a periodic message received from one network, sends a message to another network.

[0008] Also, the gateway periodically sends a message received from one network to another network.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] Fig. 1 is a block diagram showing the construction of a gateway according to one embodiment of this invention;

[0010] Fig. 2 is a flow chart showing a periodic message receiving process according to one embodiment of this invention;

[0011] Fig. 3 is a diagram showing the construction of a period/event message buffer according to one embodiment of this invention;

[0012] Fig. 4 is a flow chart showing a message value change detecting process according to one embodiment of this invention;

[0013] Fig. 5 is a flow chart showing an event message sending process according to one embodiment of this invention;

[0014] Fig. 6 is a diagram showing one example of the operation in a message transfer from a control system network to an information system network according to one embodiment of this invention;

[0015] Fig. 7 is a flow chart showing the flow of an event message receiving process according to one embodiment of this invention;

[0016] Fig. 8 is a diagram showing the construction of an event/period message buffer according to one embodiment of this invention;

[0017] Fig. 9 is a flow chart showing a periodic message sending process according to one embodiment of this invention;

[0018] Fig. 10 is a diagram showing one example of the operation in a message transfer from an information system network to a control system network according to one embodiment of this invention;

[0019] Fig. 11 is a block diagram showing the construction of a distributed system according to one embodiment of this invention;

[0020] Fig. 12 is a block diagram showing the construction of a distributed system according to another embodiment of this invention.

BEST MODE FOR EMBODYING THE INVENTION

[0021] Hereinafter, various embodiments of this invention will be described in detail with reference to the drawings.

[0022] A first embodiment of this invention will be explained with

reference to Fig. 1. This embodiment is intended to handle an event message mode, in which a message is output from a processing apparatus onto a network in response to the generation of an event, and a periodic message mode, in which a message is output from the processing apparatus onto a network at a predetermined period. It enables the exchange of messages between a network to which the processing apparatus which outputs the event message is connected (hereinafter, "an information system network" is referred to) and a network to which the processing apparatus which outputs the periodic message is connected (hereinafter, "a control system network" is referred to).

[0023] Fig. 1 shows the construction of a gateway according to this embodiment of the invention. The gateway l0 is connected to the control system network 20 and the information system network 30. A CAN (Controller Area Network) is used for the control system network 20 and information system network 30 according to this embodiment. The gateway 10 is comprised of a CPU 100, a memory 200, a bus 306, a control system network controller 400, a control system network driver 500, an information system network controller 600 and an information system network driver 700.

[0024] The CPU 100, the memory 200, the control system network controller 400, and the information system network controller 600 are connected to the bus 300, which operates as a signal line. The CPU 100 reads out a program stored in the memory 200 and controls the control system network controller 400, the control system network driver 500, the information system network controller 600 and the information system network driver 700, so that the exchange of a messages is performed between the information system network 20 and the control system network 30.

[0025] The control system network controller 400 is connected to the

control system network driver 500, and the control system network driver 500 is connected to the control system network 20, so that message transmission to the control system network 20 is carried out. The information system network controller 600 is connected to the information system network driver 700, and the information system network driver 700 is connected to the information system network 30, so that message transmission to the information system network 30 is carried out.

[0026] The memory 200 has a program stored therein for running an OS (Operating System) and application programs stored therein for a control system network communicating process 220, an information system network communicating process 230, a periodic message sending process 240, a periodic message receiving process250, an event message receiving process 260, an event message sending process 270 and a message value change detecting process 280; and, the memory 200 also has data storing areas, such as an event/period message buffer 201 and a period/event message buffer 202.

[0027] As the OS 210 in this embodiment, the OSEK-OS described in OSEK /VDX Operating System Version 2.0 revision 1 (1997) published by OSEK/VDX is utilized. Thus, by using this OS, it is possible to cause the application programs to start up periodically as tasks, and a message on the network to start up in response to a received event.

[0028] Also, as the control system network communicating process 220, the OSEK-COM described in OSEK/VDX Communication Version 2.1 revision 1 (1998) published by OSEK/VDX is utilized. The OSEX-COM operates to perform both message sending and message receiving. Also, it has a function of specifying a message for reception in accordance with an ID attached thereto. Therefore, it is possible to

specify a message to be received among periodic messages on the control system network 20.

[0029] In a case where a message is transmitted to the control system network 20, by calling out Send Message ( ), which is one API Service of the OSEK-COM from the application program for performing the periodic message sending process, it is possible to transmit the message onto the control system network 20 through the control system network controller 400. Also, in receiving a message from the control system network 20, the predetermined ID of the message to be received is managed, and when messages having the same ID are received, the control system network controller 400 performs a reception interrupt. In response, to the reception interrupt from the control system network controller 400, an interrupt process for the message reception processing of the control system network communicating process is started up, and it becomes possible to take the message on the control system network 20. The message fetched in can be read out by calling out Receive Message ( ), which is one of the API Services of the OSEK-COM.

[0030] In this embodiment, the information system network communicating process 230 also uses the OSEK-COM. Therefore, also in a case where a message is sent to the information system network 30, an application program for performing the transmission process of the event message is executed by calling out therefrom Send Message ( ), which is one of the API Services of the OSEK-COM, whereby the message can be sent onto the information system network 30 through the information system network controller 600. Also, in receiving a message from the information system network 30, the predetermined ID of the message to be retrieved is managed, and when messages having the same ID are received, the information system

network controller 600 performs a reception interrupt. In response to the reception interrupt from the information system network controller 600, an interrupt process for the message reception of the information system network communicating process is started up, and it becomes possible to take the message on the information system network 30. The message fetched in can be read out by calling out Receive Message ( ), which is one of the API Services of the OSEK-COM.

[0031] Next, the operation of the gateway 10 according to this embodiment .will be explained. First, the case where a message is transferred from the control system network 20, which handles periodic messages, to the information system network30, which handles the event messages, will be explained.

[0032] As stated above, when the control system network controller 400 receives a message having a predetermined ID from among a plurality of periodic messages on the control system network, it will perform an interruption. In response thereto, the OS 210 starts up the program of the periodic message receiving process 250. This program of the periodic message receiving process 250 is executed as one task. Since the control system network 20 will transmit messages periodically, this process (task) is also started up periodically.

[0033] The processing flow of a periodic message receiving Process 2500, which is part of the periodic message receiving process 250, will be explained with reference to Fig. 2. First, the periodic message receiving Process 2500 reads out a received message which was taken from the control system network 20 (Process 2501). This is executed by calling out Receive Message of the control system network communicating process 220, as mentioned above.

[0034] Next, the message read out is stored in the period/event message

buffer 202 (Process 2502). Now, the construction of the period/event message buffer 202 will be explained with reference to Fig. 3. As explained above, a message has an ID (identifier) attached thereto. The period/event message buffer 202 includes a message ID storing area 20210, a this-time-value (value of the most recent message) storing area 20220 and a last-time-value (value of the message received most previously after the most recent message) storing area 20230. Further, these areas are divided into storing areas per ID. That is, the ID storing area 20210 comprises an area 20211, an area 20212, an area 20213, etc. The this-time-value storing area 20220 comprises an area 20221, an area 20222, an area 20223, etc. per respective ID. The last-time-value storing area 20230 also comprises an area 20231, an area 20232, an area 20233, etc. per ID. For example, the message of ID2 is stored so that the value (2) of its ID is memorized in the area 20211, the this-time-value (20) is memorized in the area 20221 and the last-time-value (18) is memorized in the area 20231.

[0035] In Process 2502, the value of the message read out is stored in the storing area of the this-time-value corresponding to the ID of this message. For example, in the case of the message of which is ID is 2, the value of the message read out is stored in the area 20221. In the case of the message having an ID of 6, the value of the message read out is stored in the area 20222.

[0036] Lastly, a message value change detecting process 2800 is started up (Process 2503). In starting up it, the message ID of the received message is given.

[0037] Next, the message value change detecting process 2800, which is part of the message value change detecting process 280, will be explained with reference to Fig. 4. The message value change detecting process 280 is started up from the periodic message receiving processes explained above.

[0038] The message value change detecting process 2800, when started up, first reads out the message stored in the period/event message buffer 202 to check whether or not the this-time-value of the received message is different from the last-time-value thereof (Process 2801). For example, if in Fig. 3 the ID of the message is 2, both are different since its this-time value is 20 and its last-time-value is 18. If the ID of the message is 6, both are the same since its this-time-value is 6400 and its last-time-value is also 6400. If the last-time-value and the this-time-value are different from each other, the event message sending process 270 is started up (Process 2802 whereas if the last-time-value and the this-time-value are the same, the processing is completed without any additional process.

[0039] Next, an event message sending process 2700, which is part of the event message sending process 270, will be explained by with reference to Fig. 5. The event message sending process 2700 is started up in a case where the value of the message fetched from the control system network is different from the last-time-value.

[0040] First, the event message sending process 2700 reads out the this-time-value of the message sent from the period/event message buffer 202 (Process 2701). For example, in Fig. 3, if the message having an ID of 2 is intended to be sent, the this-time-value 20 stored in the area 20221 is read out.

[0041] Next, by calling up the information system network communication process 230, the transmission of the message is effected (Process 2702). This can be executed by calling out Send Message ( ), as stated above in this embodiment, the messages are transmitted by using the same ID both in the control system network and in the information system network. Although different IDs can be used in the control system and the information system, in such case it is necessary to

memorize the correspondence between the ID used in the control system and the ID used in the information system.

[0042] Lastly, the this-time-value of the periodic event message buffer 202 is stored as the last-time-value (Process 2703). For example, in Fig. 3, in the case of the message having an ID of 2, the value which was stored in the area 20221 is stored in the area 20231.

[0043] The above-described explanation is directed to the operation for transferring a message from the control system network 20, which handles the periodic messages, to the information system network 30, which handles the event messages. An example of the operation for message transfer from the control system network 20 to the information system network 30 will be explained with reference to Fig. 6.

[0044] Fig. 6 shows, for the message having the ID of 2 in Fig. 3, the reception timing of the periodic message from the control system network 20, the transmission timing of the event message to the information system network 30, and the change of the storing area 20221 for the this-time-value of the message having the ID of 2 of the period/event message buffer. In the figure, the flow of time is represented downwardly.

[0045] Periodic messages are generated at a constant period and are received as messages 20251, 20252, 20253, 20254, 20255. Incidentally, in this case, it is supposed that before the periodic message 20251 is received, the this-time-value of the message is 15. The value of the periodic message 20251 is 15, the values of messages 20252, 20253 and 20254 are 18 and the value of message 20255 is 20. When the periodic message 20252 is received, the this-time-value changes from 15 to 18, and, at this time, the event message 20261 having a value of 18 is transferred. Also, when the

periodic message 20255 is received, the this-time-value changes from 18 to 20, and, at this time, the event-message 20262 having a value of 20 is transmitted.

[0046] As explained above, only that message for the control system network 20, which is received periodically, and which, at the time, has a value which is different from the value which was received the last time, is transferred to the information system network 30.

[0047] Next, message transfer from the information system network 30, which handles event messages, to the control system network 20, which handles periodic messages, will be explained. In this embodiment, it is presumed that all of the messages of the control system network 20 have the same sending period.

[0048] The event message receiving process 260 is executed as one task. This task is started up in response to the reception of a message on the information system network by means of the OS 210. Since on the information system network 30 the message is delivered in response to an event, this process (task) is also started up periodically in response to this event.

[0049] The f low of an event message receiving process 2600, which is part of the event message receiving process 260, will be explained with reference to Fig. 7. The event message receiving process 2600 first, reads out the received message fetched from the information system network 30 (Process 2601). This is executed by calling Out Receive Message ( ) of the information system network communicating process 230, as explained above.

[0050] Next, the message read out is stored in the event/period message buffer 201 (Process 2602). Now, the construction of the event/period message buffer 201 will be explained with reference to Fig. 8. The event/period message buffer 20l has a

message ID storing area 20110 and a value storing area 20120. Further, these areas are divided into storing areas per ID. That is, the ID storing area 20110 is comprised of an area 20111, an area 20112, an area 20113, etc. The value storing area 20120 is comprised of an area 20121, an area 20122, an area 20123, etc. In Fig. 8, for example, in the case of the message having the ID value of 1, the value of the message read out is stored in the area 20121. In the case of the message having the ID value of 5, the value of the message read out is stored in the area 20122.

[0051] Next, a periodic message sending process 2400, which is part of the periodic message sending process 240, will be explained with reference to Fig. 9. The periodic message sending process 2400 is started up periodically by the OS 210 in accordance with the transmission period of the message of the control system network. As mentioned above, in one embodiment of this invention, it is presumed that the transmission period of all of the messages of the control system network 20 is the same.

[0052] The periodic message sending process 2400 first reads out the value of the message to be delivered from the event/period message buffer 201 (Process 2401). Incidentally, all of the messages to be sent are managed with reference to their IDs. For example, in Fig. 8, in a case where the message having an ID of 1 has been registered as the message to be sent, the this-time-value 100 stored in the area 20121 is read out.

[0053] Thereafter, the control system network communicating process 220 is called out to effect the transmission of the message (Process 2402). This can be achieved by calling out Send Message ( ), as mentioned above. In this embodiment, the messages are transferred with the same ID in both the control system and the information system, as mentioned above. Although different IDs can be used in the control system

and the inf ormation system, in such case, it is necessary to memorize the correspondence between the ID used in the control system and the ID used in the information system.

[0054] The above-mentioned process 2401 and process 2402 are repeated until the processing of all messages is completed (Process 2403).

[0055] The above description is directed to the operation of transferring messages from the information system network 30, which handles the event messages, to the control system network 20, which handles the periodic messages. An example of the operation of transferring messages from the information system network 30 to the control system network 20 will be explained with reference to Fig. 10.

[0056] Fig. 10 shows, for the message having the ID of 1 in Fig. 7, the reception timing of the event message received from the information system network, the transmission timing of the periodic message to the control system network 20, and the change of the value in the storing area 20121 of the message having the ID of 1 in the event/period message buffer. In the figure, the downward flow of time indicates the passage of time.

[0057] The event messages are received as messages 20161, 20162 and 20163. The value of the event message 20161 is 80, the value of message 20162 is 90, and the value of message 20163 is 100. On the other hand, the periodic messages are generated at a constant period and are delivered as messages 20151, 20152, 20153, 20154 and 20155. As the value of the periodic message, the value in the storing area 20151 for the message value at the point of time of the delivery is used. Therefore, the values of the periodic messages 20151, 20152 and 20153 are 80, and the values of the periodic messages 20154 and 20155 are 100. Incidentally, after the periodic message 20153 has been delivered, although the value changes to 90 in response to the reception

of the event message 20162, this event message having the value of 90 is not delivered, since before the next periodic message is delivered, the value changes to 100 in response to the reception of the event message 20163.

[0058] As mentioned above, the messages of the information system network as received periodically in response to events are delivered to the control system network periodically.

[0059] An example of a distributed system for an automobile using the gateway of this embodiment is shown in Fig. 11. This distributed system is comprised of two networks, a control system network 20 and an information system network 30, which are connected through the gateway 10, as explained above.

[0060] To the control system network 20, there is connected the gateway 10, as well as an engine controlling unit 40 for controlling the automobile engine and an ACC (Adaptive Cruise Control) controlling unit 50 for performing automobile travelling control to maintain the distance between it and a preceding car constant. Between the engine controlling unit, the ACC controlling unit and the gateway, information is exchanged by way of periodic messages.

[0061] To the information system network 30, there is connected the gateway 10, as well as a navigation system 60 for performing course guidance and an internet terminal 70 for connecting to the internet to gather information. Between the navigation system, the internet terminal and the gateway, information is exchanged by way of event messages.

[0062] With such a system construction, it is possible to exchange information between the navigation system and the ACC unit or between the navigation system and the engine controlling unit. For example, it is possible to realize the function

of performing inter-car distance control within a range below the restricted speed by delivering course limited speed information from the navigation system to the ACC unit. Also, by delivering engine status information, such as engine speed or the like, from the engine controlling unit to the navigation system, it is possible to observe the engine status on the screen of the navigation system.

[0063] The foregoing detailed explanation was directed to one embodiment of this invention. In accordance with this invention, in a distributed system having an information system network and control system network within an automobile, a periodic message suitable for the exchange of information for control can be used in the control system network and an event message suitable for exchange of information for information processing can be used in the information system network, and the control system network and the information system network in the automobile can be connected effectively.

[0064] Also, in accordance with this invention, the periodic message receiving process is started up in response to a received event of a message on the control system network. With it, it is possible to start up the receiving process as soon as the periodic message received, and also to deliver the event message, immediately in response to a change of value. As a result, any time delay following the message transfer from the control system network to the information system network can be minimized.

[0065] Also, in accordance with the above-described embodiment of this invention, both the control system network and the information system network were configured using a DAM network. Thus, by using the same kind of network in both networks, it is possible to make the system construction simple. Also, in the hardware, it is possible to use a micro-controller which houses the CPU, the memory and two CAN

controllers, whereby the gateway can be installed compactly.

[0066] The control network 20 according to the above-described embodiment of this invention was constructed using a CAN network, but a network such as SAE/J1850, TTP (Time-Triggered Protocol) or the like may be used. Also, in accordance with this invention, the CAN network was used in the information system network, but instead, a network such as D2B Optical, IDB (ITS DATA Bus), VAN (Vehicle Area Network) or the like may be used. It is possible to use different networks between the control system network and the information system network. Since these various networks can be used, it is possible to cope with a wider range of automobile systems. Also, by using a high speed network, it is possible to realize a system with high performance.

[0067] In the above-described embodiment of this invention, a network communication process according to the OSEK-COM specification was used in the control system network communicating process 220 and the information system network communicating process 230. However, it is possible to use a control system network communicating process or information system network communicating process according to a specification, such as IDB or the like. With this, it is possible to apply the invention to a wider range of automobile systems.

[0068] In the above-described embodiment of this invention, the transmission period of the control network was made constant regardless of the message, but it is possible to change the period per message. In this case, it is necessary to memorize in the memory 200 the correspondence between the ID and the transmission timing of the periodic message. The OS210 starts up the control system network communicating process 220 in conformity to the transmission timing of the periodic

message, and transfers the ID of the message to be sent. The control system network communicating process 220, on the basis of the ID transferred from the OS 210, reads out the message having that ID from the event/period message buffer, and performs the message transmitting process. Thus, it is possible to set up the most appropriate transmission period per message and to use the network effectively.

[0069] In the above-described embodiment of this invention, bi-directional message transfer was effected between the control system network and the information system network. However, it may be modified to one directional transfer from the control system network to the information system network or from the information system network to the control system network. Thus, the exchange of information is limited so as to improve the security.

[0070] In the above-described embodiment of this invention, the periodic message receiving process was started up in response to the reception of a message on the control system network. However, it may be started up at the same period as the periodic message.

[0071] Now, a case where the periodic message receiving process is started up at the same period as the periodic message will be explained. In this case, the correspondence between the message ID to be received and the startup timing of the periodic message receiving process and the correspondence between the message ID to be sent and the startup timing of the periodic message sending process are stored in the memory 200. The OS 210 manages the startup timing of the periodic message receiving process and the startup timing of the periodic message sending process, and starts the periodic message receiving process 250 and the periodic message sending process 240. Also, the OS 210, when starting up the periodic message sending process 240, delivers

the periodic message ID to be sent. In response thereto, the periodic message sending process shown in Fig. 9 is carried out, and the message corresponding to the delivered ID is transmitted. Also, the OS 210, when starting up the periodic message receiving process 250, delivers tire periodic message ID to be received. In response thereto, the periodic message receiving process shown in Fig.. 2 is executed, and the reception of the message corresponding to the delivered ID is performed.

[0072] Also, the periodic message receiving process may be performed as the same task as the periodic message sending process. By this, it is possible to make the task construction simple.

[0073] In the above-described embodiment of this invention, the OS was used and the task was started up under control of the OS. However, instead, it is possible to start up and execute, without the OS, the periodic message receiving process by interrupt from the control system network controller, the event message receiving process by interrupt from the information system network controller and the periodic message sending process by interrupt from a timer. Thus, the OS becomes unnecessary and a reduction of the cost can be achieved.

[0074] In the above-described embodiment of this invention, one control system network and one information system network were connected. Thus, the networks 20 and 30, the network controllers 400 and 600, and the network drivers 50 and 700 corresponding to the control system network and information system network, respectively, were provided. However, instead,, it is possible to connect a plurality of control system networks and a plurality of information system networks. To this end, it is necessary to provide a number of control system network controllers, a number of control system network drivers and the control system networks corresponding to the

number of the plurality of control system networks, respectively. Further, in the control system network communicating process 220, a function for performing allocation to this plurality of control system networks on the basis of the network IDs is provided. Also, the respective number of the information system network controllers, information system network drivers and information system networks correspond to the number of the plurality of information system networks, and a function is provided for performing allocation to these plurality of information system networks. In this way, it is possible to cope with a large-scale system.

[0075] In the control system according to the above-described embodiment of this invention, only the periodic message was used. However, instead, it is possible to use a mixture of event messages and periodic messages in the control system network. In this case, at the time of transfer from the control system network to the information system network, the periodic message is transferred after it is converted to an event message, as in the described embodiment of the invention, whereas the event message is transferred as it is. Also, in the case of transfer from the information system network to the control system network, there are methods for transforming an event message into a periodic message, as in the described embodiment of this invention, and for transferring it as it is. It is possible to properly use them depending upon the message. In this way, it is possible to use an event message also in the control system; and, in a case where information having lesser changes is exchanged, it is possible to reduce the load of the network.

[0076] In the information system network according to the above-described embodiment of this invention, only the event message was used. However, instead, it is possible to use a mixture of event messages and periodic messages in the

information system network. In this case, when the transfer from the information system network to the control system network is carried out, the event message is transferred after it is transformed into a periodic message, as in the case of the above-described embodiment of this invention, whereas the periodic message is transferred as it is. In the case of transfer from the control system network to the information system network, there are methods for transforming a periodic message into an event message, as in the above-described embodiment of this invention, and for transferring it as a periodic message. It is possible to properly use them depending upon the message. In this way, it is possible to use the periodic message also in the information system, and to improve real-time capacity as to multi-media information, such as an image, and audio.

[0077] In the above-described distributed system according to this invention, the control system network and the information system network were connected through a gateway which is a type of independent arrangement, but the gateway function may be incorporated within the controlling unit of the control system. An embodiment incorporating this feature is shown in Fig. 12. In this embodiment, there are a control system network 20 and an information system network 30. To the control system network 20, an engine controlling unit 40 and an ACC control unit 50 are connected. Also, to the information system network 30, the engine controlling unit 40 and a navigation system 60 are connected. In this embodiment, a gateway function 410 is incorporated within the engine controlling unit 40 to cause the engine controlling unit 40 to have a gateway function. The gateway function 410 can be realized in a similar way to the gateway in the previously described embodiment of this invention. In this way, there is no need to use an independent gateway, and therefore it is possible to reduce the cost.

[0078] In accordance with this embodiment of the invention, the function

of the gateway is realized by means ofsoftware, but it ispossible to achieve the same function by means of hardware. In this way, an effect can be obtained in that the system is speeded up.

[0079] In the above-described embodiment of this invention, the control system network for transmitting a periodic message and the information system network for transmitting an event message were connected, but with a network for transmitting a periodic message and a network for transmitting an event message, the invention is not limited to the use of a control system network and an information system network, respectively. For example, it is possible to provide a power train system control network using periodic messages and a body system control network using event messages, respectively. Also, the invention is not limited to use in an automobile. For example, a system having a network handling periodic messages and a network handling event messages is useful for many applications, such as an FA (Factory Automation) system, an electric power system, a railroad system, a steel producing system and the like. In this way, in a distributed system having various networks, a high efficiency gateway can be obtained.

[0080] This invention can be applied to such applications as industrial machinery, electric power systems, a railroad, steel production, an automobile or the like, in which a plurality of kinds of networks are interconnected.